INTRODUCTION TO FLUIDS

UNITS

Units

Dimensions and Base Units

The dimension of a measure is independent of any particular system of units. For example, velocity may be in meters per second or miles per hour, but dimensionally, it is always length per time, or L/T. The dimensions of the relevant base units of the Systeme International (SI) system are:

Unit-Free		**SI Units**	
Dimension	**Symbol**	**Unit**	**Symbol**
Mass	M	kilogram	kg
Length	L	metre	m
Time	T	second	s
Temperature	θ	kelvin	K

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Derived Units

From these we have some relevant derived units.

Quantity	Dimension	SI Unit	
		Derived	Base
Velocity	LT^{-1}	m/s	$m\,s^{-1}$
Acceleration	LT^{-2}	m/s^2	$m\,s^{-2}$
Force	MLT^{-2}	Newton, N	$kg\,m\,s^{-2}$
Pressure Stress	$ML^{-1}T^2$	Pascal, Pa N/m^2	$kg\,m^{-1}\,s^{-2}$
Density	ML^{-3}	kg/m^3	$kg\,m^{-3}$

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Quantity	Dimension	SI Unit	
		Derived	Base
Specific weight	$ML^{-2}T^{-2}$	N/m^3	$kg\ m^{-2}\ s^{-2}$
Relative density	Ratio	Ratio	Ratio
Viscosity	$ML^{-1}T^{-1}$	Ns/m^2	$kg\ m^{-1}\ s^{-1}$
Energy (work)	ML^2T^{-2}	Joule, J Nm	$kg\ m^2\ s^{-2}$
Power	ML^2T^{-3}	Watt, W Nm/s	$kg\ m^2\ s^{-3}$

Note: The acceleration due to gravity will always be taken as 9.81 m/s^2.

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SI Prefixes

SI units use prefixes to reduce the number of digits required to display a quantity. The prefixes and multiples are:

Prefix Name	Prefix Unit	Multiple
Tera	T	10^{12}
Giga	G	10^{9}
Mega	M	10^{6}
Kilo	k	10^{3}
Hecto	h	10^{2}
Deka	da	10^{1}
Deci	d	10^{-1}
Centi	c	10^{-2}
Milli	m	10^{-3}
Micro	μ	10^{-6}
Nano	n	10^{-9}
Pico	p	10^{-12}

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SI Prefixes

Be very particular about units and prefixes. For example:

- kN means kilo-Newton = 1000 Newtons
- Kn is the symbol for knots – an imperial measure of speed
- KN has no meaning
- kn means kilo-nano – essentially meaningless

Checking the dimensions or units of an equation is very useful to minimize errors. For example, if when calculating a force and you find a pressure then you know you've made a mistake.